IN VIVO MEASUREMENT OF BLOOD CLOT STRENGTH FROM COMPUTATIONAL FLUID DYNAMICS BASED ON INTRAVITAL MICROSCOPY IMAGES

Abstract Authors

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Abstract Text

Thrombo-embolic infarction is the major cause of mortality and morbidity in the United States. Conversely, deficiencies in these processes result in severe bleeding risks. The ability to access hydrodynamics stresses at which thrombus structure is likely to embolize can provide insight into the thrombogenesis process. Interestingly, the viscoelastic behavior exhibited by the thrombi resembles that of a Bingham fluid - a material that behaves as a rigid body at low stresses but flows as a viscous fluid when the stress exceeds critical yield stress. Hence, we decided to measure the critical yield stress at which the thrombi yield (and possibly emboli). The fluid-induced stresses are calculated via Lattice-Boltzmann Method (LBM) fluid dynamic simulation based on in vivo microscopic images of laser injury-induced thrombi in a mouse microcirculation and simulation provided critical yield stress information. To our knowledge, this is the first image-based in-vivo assessment of blood clots viscoelastic nature. Furthermore, the outcome of our work can assist in creating simpler thrombogenesis models that can help improve the understanding of risk factors associated with blood clotting, and ideally help researchers to reduce risks of occlusion and embolism in patients.

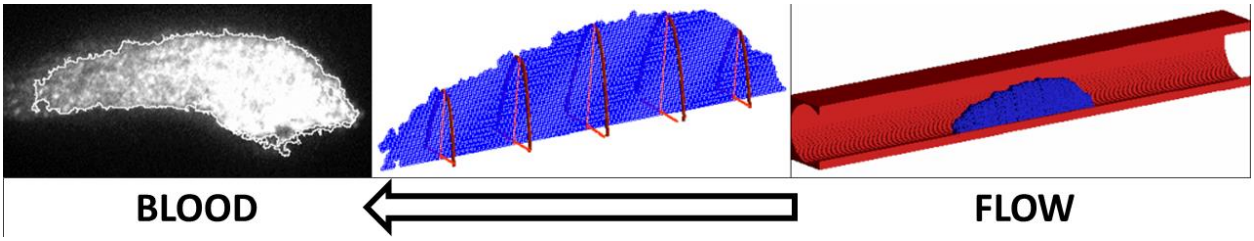

Figure 1 LEFT: 2D confocal microscopy image of a blood clot; CENTER- estimation of the 3D thrombus shape from the 2D image; RIGHT: Final reconstruction of the 3D thrombus in a blood vessel, used as model input for the LBM.